USDA
NATURAL RESOURCES
CONSERVATION SERVICE

DELAWARE CONSERVATION
PRACTICE STANDARD

SURFACE DRAINAGE
MAIN OR LATERAL

CODE 608
(Reported by Feet)

DEFINITION

An open drainage ditch constructed to a designed size and grade.

PURPOSES

This practice may be applied as part of a water management system to collect and convey excess surface or subsurface water.

CONDITIONS WHERE PRACTICE APPLIES

This standard applies to ditches for conveyance of surface and subsurface drainage water primarily collected by drainage field ditches and subsurface drains.

It provides minimum drainage requirements for multiple-purpose channels that provide drainage outlets for agricultural lands. Mains or laterals having a drainage area of more than 1 square mile must meet the stability and maintenance requirements of the standard for Open Channel (582). This standard does not apply to collection of water with a drainage field ditch. Standard for Surface Drainage - Field Ditch (607), should be used for that situation.

All lands to be drained shall be suitable for agriculture after installation of required drainage and other conservation practices.

Whether the outlet is by gravity flow or by pumping, the outlet shall be sufficient for the quantity and quality of water conveyed.

CONSIDERATIONS

Consider possible damages above or below the point of discharge that might involve legal actions or other offsite impacts.

Consider potential impacts on wetlands.

Consider the use of riparian buffers, filter strips, and fencing.

Consider potential water quality impacts for soluble pollutants and attached sediment pollutants.

This practice has the potential to affect National Register listed cultural resources or eligible (significant) cultural resources. These may include archeological, historic, or traditional cultural properties. Care should be taken to avoid adverse impacts to these resources. Follow NRCS state policy for considering cultural resources during planning.

CRITERIA

Criteria Applicable to All Purposes

The design and installation shall be based on adequate surveys and investigations. Compliance with all applicable federal, state and local regulations and ordinances is required. The landowner(s) shall be responsible for obtaining and complying with all applicable permits.

Drainage Requirements. Mains and laterals shall be located and designed to serve as integral parts of a surface or subsurface drainage system that meets the conservation and land use needs. The degree of drainage required by the crops shall be determined and expressed in terms of

drainage coefficients or depth and spacing of

drains.

Capacity. The ditch capacity shall be adequate to provide for the removal of excess water, based on climatic and soil conditions and the needs of crops. The required capacity shall be obtained by determining the watershed area, the required topographic, soil, and land use information; and use of the appropriate drainage coefficients.

The required capacity of open ditches for subsurface drainage in irrigated areas shall be determined by evaluating site conditions, including irrigation water deliveries, irrigation canal or ditch losses, soil stratification and permeability, deep percolation losses, field irrigation losses, subsurface drain discharge, and quantity of surface water to be carried by the drainage ditch.

Hydraulic Gradeline. The hydraulic gradeline for drainage ditch design shall be determined from control points, including elevations of significant low areas served by the ditch and hydraulic gradelines of any tributary ditches and the outlet. If control point elevations are estimated rather than computed from survey data, the hydraulic gradeline shall be no less than:

1. 1 ft. below fields that will receive normal drainage from ditches draining more than 1 mi^2.
2. 0.5 ft. for ditches draining 40 to 640 acres.
3. 0.3 ft. for ditches draining less than 40 acres.

For lands to be used only for water-tolerant crops, such as certain trees and grasses, these requirements may be modified and the hydraulic gradeline set at ground level. These provisions do not apply to channels where dikes contain flow.

The effects of hydraulic losses caused by culverts, bridges, or other obstructions in the channel section shall be considered.

Depth. Drainage ditches shall be designed deep enough to allow for normal siltation. Ditches that serve as outlets for subsurface drains shall be designed for a normal water surface at or below the invert of the outlet end of the drain. The normal water surface is the elevation of the usual low flow during the growing season. Where site conditions allow, the clearance between a subsurface drain invert, or a field ditch invert shall be at least 1 ft. to account for sediment accumulation in the main or lateral.

Cross Section. The design ditch cross section shall be set below the design hydraulic gradeline and shall meet the combined requirements of capacity, limiting velocity, depth, side slopes, bottom width, and, if needed, allowances for initial sedimentation.

Side slopes shall be stable, shall meet maintenance requirements, and shall be designed on the basis of on-site conditions.

The drainage guide or other local information shall be used to determine side slope limits for specific soils and/or geologic materials. If such information is not available, the design side slopes in the main or lateral shall not be steeper than those shown in Engineering Field Handbook (EFH) Part 650, Chapter 14, Section 650.1412 (d). Stability during rapid drawdown conditions must be considered.

Velocity. The maximum permissible design velocity shall be based on site conditions and shall insure stability of the ditch bottom and side slopes. Design velocities shall not be less than 1.4 ft/s to avoid excessive sedimentation.

The velocity for newly constructed channels with drainage areas in excess of 1 square mile shall meet the stability requirements specified for Open Channel (582).

Capacity Design. Manning's equation shall be used in determining the design velocity, and the value of *n* shall be based on alignment, probable vegetative growth expected with normal maintenance, other roughness factors, and the hydraulic radius. Unless special site studies are available to justify other values, the values of *n* in the EFH Part 650, Chapter 14, Section 650.1412 (d) or the local drainage guide, based on the hydraulic radius of the channel and assuming an aged channel with good maintenance and good alignment, shall be used in solving Manning's equation for mains and laterals when determining the design for required capacity.

Berms and Spoil Banks. Adequate berms at a safe distance from the drain shall be provided and shaped, as required, to provide access for maintenance equipment, to eliminate the need for moving spoil banks in future operations, to provide for work areas and facilitate spoil bank spreading, to prevent excavated material from

washing or rolling back into ditches, and to lessen sloughing of ditchbanks caused by heavy loads too near the edge of the ditchbanks. The spoil shall be spread as soon as practical. Minimum berm widths shall be those recommended in EFH Part 650, Chapter 14, Section 650.1412 (d) or the local drainage guide, except where the spoil is spread according to the standard for Spoil Spreading (572).

Where spoil material is to be placed in banks along the ditch rather than spread over adjacent fields, the spoil banks shall have stable side slopes. Provision must be made to channel water through the spoil bank and into the ditch without causing serious erosion.

Related Structures and Ditch Protection. Mains and laterals shall be protected against erosion where surface water or shallow ditches enter deeper ditches. This may be achieved through the use of chutes, drop structures, pipe drops, other suitable structures or grassed waterway, critical area seeding, filter strips, or specially graded channel entrances.

Grade control structures, bank protection, or other suitable measures shall be used if necessary to reduce velocities and control erosion.

Culverts and bridges shall have sufficient hydraulic capacity and depth to satisfy drainage needs and to minimize obstruction to flow.

Capacities of pipe or drop structures shall be determined by use of the applicable drainage coefficients. The "island-type" method of construction shall be used to protect the structure from washout by flows exceeding design capacity.

Each structure for an open ditch system shall be designed according to NRCS standards for the kind of structure and type of construction used.

Channel Vegetation. Vegetation shall be established according to the standard for Channel Vegetation (322).

SPECIFICATIONS

Plans and specifications for establishment of this practice shall be prepared in accordance with the previously listed criteria. Plans and specifications shall contain sufficient detail to ensure success of the practice. Documentation shall be in accordance with the section "Supporting Data and Documentation" in this standard.

OPERATION AND MAINTENANCE

An operation and maintenance (O&M) plan shall be prepared for each management unit. The plan shall provide specific instructions for operating and maintaining the system to insure that it functions properly. It shall also provide for periodic inspections and prompt repair or replacement of damaged components. Appropriate job sheet(s), fact sheets, or other information sheets may be used to serve as the management plan as well as supporting documentation and shall be provided to the client. These sheets shall be referenced in the conservation plan narrative.

Requirements for operating and maintaining all drainage mains and laterals having drainage areas in excess of 1 square mile shall be according to the standard for Open Channel (582).

SUPPORTING DATA AND DOCUMENTATION

The following is a list of the minimum data and documentation to be recorded in the case file:

1. Extent of planting in acres, field number, and the location of the practice marked on the conservation plan map;

2. Assistance notes shall include dates of site visits, name or initials of the person who made the visit, specifics as to alternatives discussed, decisions made, and by whom;

3. Completed copy of the appropriate job sheet(s) or other specifications and operation and management plan.

Field Data and Survey Notes

The following is a list of the minimum data needed:

1. Plan view sketch of the area, indicating field conditions, structures, size and location; side drainage, location and section; control points, etc.

2. Establish and describe a temporary benchmark.

3. Profile along centerline of drain at 100-foot intervals.

4. Cross-sections - one per design reach not to exceed 500-foot intervals taken perpendicular to flow and extending 25 feet beyond the top of each bank.

5. Location and description of fallen trees and other debris that may need to be removed.

6. Soil investigation, auger logs to determine any special construction needs.

7. Low bank at each station (if needed for critical depth).

Design Data

Record on appropriate engineering paper. For guidance on the preparation of engineering plans see Chapter 5 of the Engineering Field Handbook - Part 650. The following is a list of the minimum required design data:

1. Locate the practice on the farm plan map in the case file.

2. Plan view including job class, location map, utility notification, and construction specifications.

3. Design computations including the watershed map, drainage area, channel retardance, and design velocity and discharge.

4. Plan, cross-section and profile of drain. Record design grade, bottom width, average depth, side slopes, hydraulic gradient, and berm width for each design section of new ditch(es)

5. Soil borings, where applicable.

6. Structures, where applicable.

7. Method of disposal for debris and for the spoil.

8. Vegetative plan. Include the seedbed preparation, seeding species and rate, lime, fertilizer and mulching requirements.

9. Provide for erosion protection at the ends of crossing pipes, as appropriate.

10. Provide for the control of erosion during and following construction. Construction sequence to include stream channel diversion and sediment control measures.

11. Show job class on the plan.

12. Estimated Quantities.

Construction Check Data/As-Built Plans

Record on survey notepaper, NRCS-ENG-28, or other appropriate engineering paper. Survey data will be plotted in red on the as-built plans. The following is a list of minimum data needed for As-built documentation:

1. Documentation of site visits on CPA-6. The documentation shall include the date, who performed the inspection, specifics as to what was inspected, all alternatives discussed, and decisions made and by whom.

2. Profile notes along centerline of the constructed ditch at 100-foot intervals.

3. Cross-section notes, one per design reach on the completed ditch or as needed to determine whether planned grade and dimensions have been met.

4. Location of spoil spreading and measurements to support special features installed.

5. Location, size, type, grade, and/or pertinent elevations of any structures used for stabilization.

6. Statement as to the condition or adequacy of vegetation on the banks, and other disturbed areas.

7. Final quantities and documentations for quantity changes. Materials certifications as appropriate.

8. Sign and date check-notes and plans by someone with appropriate approval authority. Include statement that practice meets or exceeds plans and NRCS practice standards.